Key Experiments in IGCSE Biology: an overview

Testing for:	Name of Test:	Video Example:	Notes:
Glucose	Benedict's test for glucose	https://www.youtube.com/watch?v=1PE6_DGwLVA	
Lipid	the emulsion test for lipid		
Protein	biuret reagent for protein		
Starch	iodine test for starch	https://www.youtube.com/watch?v=lji6Zx3_E30	To test leaves for starch: - drop into very hot/boiling water for one minute (to destroy the cell membranes so that chlorophyll molecules can pass through) - drop into hot ethanol (to remove/dissolve the green chlorophyll) - place leaf into water (to rehydrate and soften the leaf so that it can be spread out) - drop iodine solution onto the leaf (test for starch) – blue-black colour will show the presence of starch.

Testing for:	Test:	Video Example:	Notes:
Effect of Temperature on starch digestion	Effect of temperature on digestion of starch by amylase	https://www.youtube.com/watch?v=1Fa2sSIt4_I	An example of a controlled experiment
Diffusion	Cubes of agar jelly placed into solutions of methylene blue or potassium permanganate will absorb the pigment by diffusion.	https://www.youtube.com/watch?v=xuG4ZZ1GbzI	The cubes are left in the pigmented solution for different measured periods of time and are then sliced open. The distance between the edge of each cube and the edge of the coloured agar may be used as a measure of the distance the pigment molecules have moved by diffusion.
Diffusion	A crystal of potassium permanganate can be dropped into a beaker of water and the appearance of the water noted over time.	https://www.youtube.com/watch?v=55CPfc9ij48	
Osmosis	To demonstrate osmosis	https://www.youtube.com/watch?v=0dJIkh7gMiQ	Visking tubing (dialysis tubing) can be tied at one end and filled with 20 per cent sucrose solution. The other end is attached to a capillary tube. The level of the sucrose can be noted before and after the tubing has been placed in a beaker of water for about 30 minutes.
Osmosis	Onion epidermis can be peeled away, cut into squares and mounted on slides in		Observation under a microscope will show the effects of osmosis.

	different concentrations of sucrose solution.		
Osmosis	Red blood cells in blood may be mounted on slides in hypotonic, isotonic and hypertonic saline, and observed under a microscope to show the effects of osmosis.	https://www.youtube.com/watch?v=A8cI6FkcG4c	
Osmosis	Cut potato cubes of different sizes, which have different surface area to volume ratios.	Overview of osmosis: https://www.youtube.com/watch?v=IaZ8MtF3C6M	After measuring and recording the masses of the cubes, they are immersed in water. After one hour, the cubes are blotted dry and their masses measured and recorded again. The percentage increase in mass for cubes of different surface area to mass ratio can be compared, to explore the concept of how surface area to volume ratio influences water uptake.

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Photosynthesis *Example of controlled experiment*	To show: the evolution of oxygen from a water plant,	https://www.youtube.com/watch?v=CVPGy7TrIDs	Oxygen from a water plant can be seen if a water plant (typically elodea or a similar species) is placed in a beaker of water and covered with a glass funnel that has a water-filled test tube placed over its opening. After 24 hours, a colourless gas will have displaced water from the test tube. A test for oxygen is then carried out.
Photosynthesis *Example of controlled experiment*	To show: measure the rate of oxygen production	To measure the rate of oxygen production: the stem of a water plant is cut under water, and the plant kept immersed in water in a beaker or boiling tube. The number of bubbles of gas given off over a measured time period can be counted.	Suitable variables include: light intensity (the plant is exposed to a light source and the rate of bubble production measured at different light intensities by changing the distance between the light source and the water plant); colour/wavelength of light (coloured filters are placed between the plant and the light source); and carbon dioxide availability (the plant is immersed in solutions of different concentration of sodium hydrogen carbonate)
Photosynthesis *Example of controlled experiment*	To show: The requirements for **light** for the production of starch by leaves	https://www.youtube.com/watch?v=0s_xZqvwm_s the production of starch by leaves	Place a plant in the dark for 24 hours to de-starch the leaves. A starch test on a leaf from a plant that has been kept in the dark will not

			give a blue-black colour, whereas a similar test on a control leaf from a plant kept in the light will give a blue-black colour.
Photosynthesis *Example of controlled experiment*	To show: the requirements for **chlorophyll** the production of starch by leaves	https://www.youtube.com/watch?v=7O-Lz1JK9Uk	A starch test on a variegated leaf can be used to demonstrate that chlorophyll is needed for photosynthesis
Photosynthesis Example of controlled experiment	To show: the requirements for **carbon dioxide** the production of starch by leaves		To show that carbon dioxide is needed for photosynthesis, a leaf on a plant may be surrounded by air with no carbon dioxide by inserting it into a conical flask containing a small amount of potassium or sodium hydroxide. The plant is left in good light for 24 hours. The test leaf and a control leaf from the plant are then tested for starch.

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A simple experiment to determine the *energy content* of a food sample		https://www.youtube.com/watch?v=5GvaosX1J8s	
Controlled experiments to demonstrate the evolution of ***carbon dioxide*** and ***heat*** from respiring seeds or other suitable living organisms		https://www.youtube.com/watch?v=D-dWv4V4VcI	Vacuum flasks are needed for this activity. Surface sterilised seeds are put into a flask, which is sealed with a bung. A glass tube runs from inside the flask, through the bung and into an indicator solution of either limewater or hydrogen carbonate. The *carbon dioxide produces changes the colour of the indicator solution.* To show heat production the flask needs a cotton wool bung with a thermometer going through the bung into the flask.
Simple controlled experiments to investigate the *effect of* ***light*** *on net gas exchange from a leaf*, using **hydrogen carbonate indicator**		https://www.youtube.com/watch?v=wIvz6vHYvsw	A water plant can be placed in a sealed tube of air-equilibrated hydrogen carbonate solution (red in colour) and placed in the light or in the dark. The solution will turn purple if kept in the light and will turn yellow if kept in the dark. A variation could involve the use of water snails or, if not available, small land insects placed on a gauze platform above the indicator, with and without the water plant. This variation allows you to think about the balance between carbon dioxide used by photosynthesis and carbon dioxide produced by respiration.

		A useful demonstration uses four tubes containing hydrogen carbonate solution: one with water plant only, one with animals only, one with both water plant and animals and one with no living organisms. One set of the tubes is exposed to light and left for 12 to 24 hours and another set is placed in the dark for the same length of time.

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A simple experiment to investigate the *effect of exercise on breathing* in humans	The breathing rate can be measured at rest and after a period of exercise by counting the number of inhalations per minute.		To help students appreciate that exercise also influences the rate of breathing by increasing the volume of each breath they can measure the volume of one exhalation before and after exercise. This can be done by breathing through a tube into a plastic container filled with water. The volume of displaced water can be measured. The breathing rate at rest and after exercise can be calculated as number of breaths per minute x volume of each breath.
A simple experiment to investigate the *effect of exercise on heart rate* in humans	Students should be shown how to measure and record their pulse. They can measure this at rest. A short period of exercise can follow, stepping on and off a low stool, or running up and down a flight of stairs for five minutes. The pulse rate should now be recorded for five minutes or until it returns to its rest level. This experiment can provide a great deal of interesting data on the variation in resting heart rate, the effects of exercise and how quickly the heart recovers.		(Safety note: careful supervision is required.) Discussion can include measures of fitness, heart disease, cardiac output and the effects of long-term exercise on stroke volume.
A simple experiment to show how the *sensitivity of the skin differs* on finger tips, back of hand, wrist and forearm	Students should work in pairs. A piece of hard cardboard or cork can be used to fix the two prongs of a hairpin or two pins 5 mm apart. This is then used by one student to lightly touch the fingertips of another who is looking away. The first student can use both points or one point as a stimulus. The second student then has to judge whether one or two points were used and their response recorded as correct or incorrect.		Conclusions can be made about the number of sensory nerve endings, receptive field size and the thickness of skin. This practical also provides opportunities to discuss data analysis, experiment design and anomalous results, and the benefits of grouping class results.

	This can be repeated 10 times for each area of the hand. It is then repeated using pins 1 cm apart and 2 cm apart. Students can then identify the most sensitive area as this should have the most correct responses with the smaller distance.	

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Experiments to investigate the role of ***environmental factors*** in determining the ***rate of transpiration*** from a leafy shoot		www.youtube.com/watch?v=FEfmTok3OCo	A bubble potometer can be used to illustrate the effects of light, wind, temperature and air humidity. Plants covered with dark polythene bags simulate darkness and can be compared with plants covered with transparent polythene bags. Hairdryers can simulate wind. The use of potted plants is also acceptable, where the pot and the soil is sealed with polythene and the mass of the potted plant is measured before and after a period of exposure to the environmental factor.
A practical exercise ***comparing floral structure*** in *insect-pollinated* and *wind-pollinated* flowers	Insect-pollinated flowers can be examined and the various structures observed. Wind-pollinated grasses should be available but have fewer structures to see.		
Controlled experiments to demonstrate ***phototropic*** and ***geotropic*** plant growth responses	Plant material such as wheat, maize, oat or cress seedlings can be used to demonstrate phototropism.	https://www.youtube.com/watch?v=EM77i5vEJig	Petri dishes containing moist cotton wool and the plant material can be put into light-proof boxes such as shoe boxes. To create unilateral light a small slit can be cut in one side of the box and light can be shone into the box. Control seedlings can either have aluminium caps put on their tips or can be kept in a shoe box without a slit for light. A clinostat needs to be used to demonstrate geotropism.
The use of quadrats to estimate the population	Quadrats can be used to sample part of each area. Calculation will		Students are expected to understand the importance of placing the sample quadrats randomly.

size of an organism in two different areas	be needed to work out the estimated population size. For example, if 10 quadrats have been used and the total area amounts to 100 quadrats, the estimated population size will be the number of organisms counted in the 10 sample quadrats multiplied by 10.		
A simple experiment to investigate *carbon dioxide* production by yeast in different conditions	This allows students to see that carbon dioxide is released during ***anaerobic respiration*** (fermentation).	Watch: Effect of sugar as a variable: https://www.youtube.com/watch?v=FYClCHVT00M Watch: Simple example of temperature as a variable: https://www.youtube.com/watch?v=NmUVO7K6GjA	Students add yeast to glucose solution in a side-arm test tube. Anaerobic conditions are achieved by putting a drop of oil (cooking oil will do) onto the yeast and glucose mixture. A rubber tube is attached to the side arm of the test tube and a glass pipette is inserted at the other end of the rubber tube. The pipette is placed under water to allow the bubbles of carbon dioxide gas to be counted. Temperature is the easiest condition to investigate. Glucose concentration and pH could also be investigated.